SONY International (Europe) GmbH
S30156(M)

Direct and Selective Metallisation of Nucleic Acids via Metal Nanoparticles Produced In-situ

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CLAIMS

1. A process for producing metal nanoparticle-nucleic acid composites, comprising
   reacting a nucleic acid specific metal complex with a nucleic acid to produce a metal complex-nucleic acid conjugate,
   non-conjugated metal complex and/or non-conjugated by-products are removed, and
   the metal complex-nucleic acid conjugate is reacted with a reducing agent to produce a metal nanoparticle-nucleic acid composite.

2. A process according to claim 1, characterized in that
   the nucleic acid component is reacted dissolved in a solution, immobilised on a substrate or in a semisolid state, e.g. in a gel.

3. A process according to claims 1 or 2, characterized in that the nucleic acid is selected from the group comprising DNA, RNA, PNA, CNA, oligonucleotides, oligonucleotides of DNA, oligonucleotides of RNA, primers, A-DNA, B-DNA, Z-DNA, polynucleotides of DNA, polynucleotides of RNA, T-junctions of nucleic acids, triplexes of nucleic acids, quadruplexes of nucleic acids, domains of non-nucleic acid polymer-nucleic acid block-copolymers and combinations thereof.

4. A process according to any of claims 1 to 3, characterized in that the nucleic acid is double-stranded or single-stranded.

5. A process according to any of claims 1 to 4, characterized in that the metal complex-nucleic acid conjugate is formed by metalation and/or interactive ligand binding.

6. A process according to any of claims 1 to 5, characterized in that specific bases of the nucleic acid are metalated.

7. A process according to any of claims 1 to 6, characterized in that the nucleic acid specific metal complex is selected from the group comprising dichloro(2,2':6',2''-terpyridine)platinum(II), cis-diaminodichloroplatinum(II) and metal complexes with attached or integrated nucleic acid interacting groups, like intercalating, groove binding and alkylating agents.

8. A process according to any of claims 1 to 7, characterized in that the metal complex-nucleic acid conjugate is separated from non-conjugated metal complex and/or non-conjugated by-products by chromatography, e.g. gel filtration or ion exchange, precipitation, e.g. ethanol precipitation or rinsing, e.g. with water or an aqueous salt solution.

9. A process according to any of claims 1 to 7, characterized in that the metal complex-nucleic acid conjugate is reacted with at least one reducing agent selected from the group comprising boron hydrides, borohydride salts, Lewis base:borane complexes of the general formula $L:BH_3$, in which L can be amine, ether, phosphine or sulfide, hydrazine and derivatives, hydroxylamine and derivatives, hypophosphite salts, formate salts, dithionite salts and H_2.

10. A process according to claim 9, characterized in that the reducing agent is used in the form of a gaseous reducing agent.

11. A process according to any of claims 1 to 10, characterized in that the metal nanoparticle comprises at least one metal selected from the group of Fe, Co, Ni, Cu, Ru, Rh, Pd, Ag, Os, Ir, Pt, Au or combinations (e. g. alloys) of these metals.

12. A process according to any of claims 1 to 11, characterized in that the metal nanoparticle is catalytically active towards electroless metallisation.

13. A process according to any of claims 1 to 12, characterized in that the metal nanoparticle can not be visualized by atomic force microscopy and/or that the diameter of the metal nanoparticle is smaller than 3 nm.

14. A process according to any of claims 1 to 13, further comprising the step of treating the metal nanoparticles within the metal nanoparticle-nucleic acid composite with an electroless plating solution in order to enlarge the metal nanoparticles.

15. A process according to claim 14, characterized in that the metal complex-nucleic acid composite is treated dissolved in a solution, immobilised on a substrate or in a semisolid state, e.g. in a gel.

16. A process according to claim 14 or 15, characterized in that the metal nanoparticles are treated with an electroless plating solution comprising at least one of the metals selected from the group comprising Fe, Co, Ni, Cu, Ru, Rh, Pd, Os, Ir, Ag, Pt, Au or combinations (e. g. alloys) of these metals.

17. A process according to claim 14 or 15, characterized in that the metal nanoparticles are treated with an electroless plating solution comprising at least one of the metals selected from the group comprising magnetic and/or magnetized Fe, Co, Ni, or combinations (e. g. alloys) of these metals or combinations (e. g. alloys) of these metals with B or P.

18. A metal nanoparticle-nucleic acid composite obtainable according to a method of any of claims 1 to 13.

19. A metal nanoparticle-nucleic acid composite according to claim 18, characterized in that that the metal nanoparticles have a diameter of less than 3 nm and/or can not be visualized by atomic force microscopy.

20. A process for the manufacture of a nanowire, characterized by the following steps: providing a metal nanoparticle-nucleic acid composite according to claims 18 or 19 and growth, preferably controlled growth, of the nanoparticle by electroless deposition of a metal according to any of claims 16 or 17.

21. A linear array of metallic nanoparticles or a nanowire obtainable according to a method of claim 20.

22. A small-scale network or electronic circuit comprising at least one nanowire according to claim 21.

23. Use of the process according to any of claims 1 to 17 for the selective metallisation of a nucleic acid.